Chapter 40 – Fall Protection Program (REDACTED)

40.1 Purpose

The purpose of the Ames Research Center Fall Protection Procedure is to implement practices and procedures that will protect workers from fall hazards. This can be accomplished by:

1. The survey, inventory and evaluation of the workplace to determine what fall hazards exist.
2. Selecting appropriate fall protection systems where protection is required.
3. Assuring proper construction and installation of such systems.
4. Assuring proper supervision of employees and the use of safe work practices.
5. Providing training to employees in the recognition of fall hazards and the selection, use and maintenance of fall protection systems.

40.2 Scope and Applicability

This procedure applies to all Civil Servant employees, on-site contractors, and all subcontractor personnel working at NASA Ames Research Center. Fall protection measures must be implemented whenever personnel are exposed to the following conditions:

1. A fall four or more feet to the ground or to the next lower level during the course of normal work duties.
2. A fall of six or more feet to the ground or to the next lower level when working on construction-related activity.

40.2.1 Operations and Areas Covered

Operations and areas at ARC where potential fall hazards exist include, but may not be limited to, the following:

- Aerial Lifts
- Attic work
- Construction sites
- Elevators shafts
- Excavations
- Heat exchange
- Instrumentation and equipment
- Ladders
- Leading Edge
- Lofts
- Model installation
- Roof work
- Scaffolds
- Tree trimming
- Trenches
- Vane set adjustment
- Wind tunnels
- Work platforms > 4 ft.

40.2.2 Other Hazards

Working in elevated locations may involve other safety hazards that are not directly addressed by this procedure. These hazards may include, but are not limited to, work conducted around energized systems that should be addressed using procedures from the Electrical Safety Program.

40.3 Definitions

40.3.1 General Fall Protection

1. **Anchorage**--A secure point of attachment for lifelines, lanyards or deceleration devices.
2. **Body harness**--Straps that may be secured about the person in a manner that distributes the fall-arrest forces over at least the thighs, pelvis, waist, chest, and shoulders with a means for attaching the harness to other components of a personal fall arrest system.
3. **Connector**--A device that is used to couple (connect) parts of a personal fall arrest system or positioning device system together.
4. **Controlled access zone**--A work area designated and clearly marked in which certain types of work (such as over-hand bricklaying) may take place without the use of conventional fall protection systems--guardrail, personal arrest or safety net--to protect the employees working in the zone.
5. **Deceleration device**--Any mechanism--such as rope, grab, ripstitch lanyard, specially woven lanyard, tearing or deforming lanyards, automatic self-retracting lifelines/lanyards--which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limits the energy imposed on an employee during fall arrest.
6. **Deceleration distance**--The additional vertical distance a falling person travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which a deceleration device begins to operate.
7. **Guardrail system**--A barrier erected to prevent employees from falling to lower levels.
8. **Hole**--A void or gap 2 inches (5.1 centimeters) or more in the least dimension in a floor, roof, or other walking/working surface.
9. **Lanyard**--A flexible line of rope, wire rope, or strap that generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline, or anchorage.
10. **Leading edge**--The edge of a floor, roof, or formwork for a floor or other walking/working surface (such as the deck) which changes location as additional floor, roof, decking, or formwork sections are placed, formed or constructed.
11. **Lifeline**--A component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), and that serves as a means for connecting other components of a personal fall arrest system to the anchorage.
12. **Low-slope roof**--A roof having a slope less than or equal to 4 in 12 in (vertical to horizontal).
13. **Opening**--A gap or void 30 inches (76 centimeters) or more in height and 18 inches (46 centimeters) or more in width, in a wall or partition, through which employees can fall to a lower level.
14. **Positioning device system**--A body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning backwards.
15. **Rope grab**--A deceleration device that travels on a lifeline and automatically, by friction, engages the lifeline and locks to arrest a fall.
16. **Safety-monitoring system**--A safety system in which a competent person is responsible for recognizing and warning employees of fall hazards.
17. **Self-retracting lifeline/lanyard**--A deceleration device containing a drum-wound line, which can be slowly extracted from, or retracted onto, the drum under minimal tension during normal employee movement and which, after onset of a fall, automatically locks the drum and arrests the fall.

18. **Naphook**--A connector consisting of a hook-shaped member with a normally closed keeper, or similar arrangement, which may be opened to permit the hook to receive an object and, when released automatically, closes to retain the object.
19. **Steep roof**--A roof having a slope greater than 4 to 12 (vertical to horizontal).
20. **Toeboard**--A low protective barrier that prevents material and equipment from falling to lower levels and which protects personnel from falling.
21. **Unprotected sides and edges**--Any side or edge (except at entrances to points of access) of a walking/working surface (e.g., floor, roof, ramp, or runway) where there is no wall or guardrail system at least 39 inches (1 meter) high.
22. **Walking/working surface**--Any surface, whether horizontal or vertical, on which an employee walks or works, including but not limited to floors, roofs, ramps, ridges, runways, formwork, and concrete reinforcing steel. Does not include ladders, vehicles, or trailers on which employees must be located to perform their work duties.
23. **Warning line system**--A barrier erected on a roof to warn employees that they are approaching an unprotected roof side or edge and which designates an area in which roofing work may take place without the use of guardrail, body belt, or safety net systems to protect employees in the area.

40.3.2 Ladders and Stairs

1. **Cleat**--A ladder crosspiece of rectangular cross section placed on edge upon which a person may step while ascending or descending a ladder.
2. **Double-Cleat Ladder**--A ladder with a center rail to allow simultaneous two-way traffic for employees ascending or descending.
3. **Failure**--Load refusal, breakage, or separation of components.
4. **Fixed Ladder**--A ladder that cannot be readily moved or carried because it is an integral part of a building or structure.
5. **Handrail**--A rail used to provide employees with a handhold for support.
6. **Job-Made Ladder**--A ladder that is fabricated by employees, typically at the construction site; non-commercially manufactured.
7. **Load Refusal**--The point where the structural members lose their ability to carry the load.
8. **Point of Access**--All areas used by employees for work-related passage from one area or level to another.
9. **Portable Ladder**--A ladder that can be readily moved or carried.
10. **Riser Height**--The vertical distance from the top of a tread or platform/landing to the top of the next higher tread or platform/landing.
11. **Side-Step Fixed Ladder**--A fixed ladder that requires a person to get off at the top to step to the side of the ladder side rails to reach the landing.
12. **Single-Cleat Ladder**--A ladder consisting of a pair of side rails connected together by cleats, rungs, or steps.
13. **Stair-rail System**--A vertical barrier erected along the unprotected sides and edges of a stairway to prevent employees from falling to lower levels.
14. **Temporary Service Stairway**--A stairway where permanent treads and/or landings are to be filled in at a later date.
15. **Through Fixed Ladder**--A fixed ladder that requires a person getting off at the top to step between the side rails of the ladder to reach the landing.
16. **Tread Depth**--The horizontal distance from front to back of a tread, excluding nosing, if any.

40.4 References

- 29 CFR Part 1926 Safety and Health Regulations for Construction
  - Subpart L - Scaffolds (1926.450 to 1926.454)
  - Subpart M - Fall Protection (1926.500 to 1926.503)
  - Subpart X - Ladders (1926.1050 to 1926.1060)
- 29 CFR Part I9I0
  - Subpart D - Walking-Working Surfaces (1910.21-1910-30)
  - Subpart F - Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms (1910.66-1910.68)

40.5 Responsibilities

40.5.1 Employees

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40.5.2 Managers and Supervisors

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40.5.3 Safety, Health, & Medical Services Division (QH)

1. Develop Ames Fall Protection policy and maintain this chapter.
2. Provide technical assistance with the evaluation of fall hazards.
3. Consult on selection of fall protection systems and equipment.

40.5.4 Facilities Engineering Branch (FEF)

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40.5.5 Contractors

1. Read and understand ARC's fall protection procedures.
2. Develop systems to ensure compliance with this procedure.
3. Ensure all employees receive fall protection training specific to their job and responsibilities.

40.6 Training

40.6.1 Managers and Supervisors

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40.6.2 Employees and Contractors

All employees and contractors, who conduct work in elevated locations, or whose work requires the use of fall protective devices, shall be trained to use this equipment in a safe manner. Employees shall be trained to recognize work site conditions that require fall protection or the use of fall protective devices such as: guardrails, safety nets, personal fall restraint systems, personal fall arrest systems, and positioning device systems.

40.7 General Safety Concepts

40.7.1 Selection and Use of Work Practices

Selection of fall protection systems must be consistent with the requirements of this chapter and in compliance with applicable Federal OSHA standards. The work practices and fall protective devices used shall be consistent with the nature and extent of the fall hazard present on the job site.

40.7.2 Self-Retracting Lifelines

Self-retracting lifelines and lanyards which automatically limit free fall distance to 2 feet or less shall be capable of sustaining a minimum tensile load of 3,000 pounds applied to the device with the lifeline or lanyard in the fully extended position.

40.7.3 Standard Railing 29 CFR 1910.23, 29 CFR 1926.502

Standard railings are required on all exposed sides of industrial stair openings, ladderways, open skylights, and holes in floors. For open-sided floors, platforms, catwalks, and other walkways, standard railings are required where there is a drop of more than 4 feet. (Exit stairways and other openings, which are accessible to the public, must meet more stringent regulations.) A standard railing consists of a top rail, intermediate rail and posts. The top rail must be 39 to 45 inches high and the intermediate rail shall be placed approximately halfway between the top rail and the floor or walking surface. Regardless of height, any walkways, platforms, etc. above or adjacent to chemical tanks or other dangerous equipment must be guarded with a standard railing.

Removable standard railings are permitted where traffic across an opening prevents the use of fixed standard railings. This includes stair openings, hatchways, chute floor openings, pits and trap door openings. Unhinged covers may be used on manhole openings. The covers themselves should have no holes or slots greater than one-inch in diameter.

40.7.4 Toeboards 29 CFR 1910.23, 29 CFR 1926.502

Toeboards are required around ladderways, hatchways, open-sided floors, platforms, and catwalks where material or equipment might fall or roll into the opening. A standard toeboard must be 4 inches high, with not more than 1/4-inch clearance above floor level. It may be solid or with holes or slots not exceeding one inch in greatest dimension.

40.7.5 Wall Openings 29 CFR 1910.23

Every opening in a wall in which there is a drop of more than 4 feet must be guarded by a rail, roller, picket fence, half door, or equivalent barrier. The guard should be hinged but may be removable if mounted so as to be easily replaceable. A removable toeboard is required if employees below the work area may be exposed to falling materials.

40.7.6 Handrails 29 CFR 1910.24

Every flight of stairs having 3 or more risers must be equipped with a handrail 30 to 34 inches high (see NFPA 101 or the OSHA standards for more detailed requirements). If the stairway is not enclosed there must be handrails on both sides.

40.7.7 Safety Nets 29 CFR 1926.105

Where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical, safety nets shall be provided when workplaces are more than 20 feet above the ground, water, or other surface.

40.7.8 Work Site Isolation

Prior to the start of roof construction, repair, or maintenance, the crew chief, foreman, or person in charge of the project shall ensure that the area below the work site is isolated against entry by the use of barrier tape or other means. If means of egress are to be blocked by ladders, scaffolds, or other equipment, or to isolate below a work site, prior approval must be obtained from the safety department representative.

40.7.9 Personal Protective Equipment

Employees involved in roof construction, repair, or maintenance operations shall use appropriate personal protective equipment including, but not limited to, hard hats, eye protection, and leather gloves.

40.8 Safety Procedures

40.8.1 Roof Work

1. Roof construction, repair, and other maintenance operations often require manual labor at dangerous heights and on steeply pitched working surfaces. The possibility of lost footing, decreased stability, and objects falling from such heights is great; appropriate employee safeguards shall be present. When employees of NASA Ames Research Center are involved in such operations, the following minimum safety guidelines shall be followed to promote a safe and healthful workplace and guard against injury to others below the work area.
2. A substantial catch platform shall be installed below the working area of roofs more than 20 feet from ground to eaves without a parapet, or 16 feet from ground to eaves with a slope greater than 4 inches in 12 without a parapet. The platform shall extend 2 feet in width beyond the projection of the eaves and shall be provided with a safety rail, mid-rail, and toeboard. This provision shall not apply where a safety harness attached to a lifeline protects employees engaged in work upon such roofs.
3. Employees performing duties on a roof more than 20 feet from ground to eaves without a parapet, or 16 feet from ground to eaves with a slope greater than 4 inches in 12 inches without a parapet, shall be secured by an approved safety harness attached to a lifeline. The safety harness lanyard shall be a minimum of 1/2-inch nylon, or equivalent, with a maximum length to provide for a fall of no greater than 6 feet. The rope shall have a nominal breaking strength of 5,000 pounds. Body belts are not acceptable as part of a personal fall arrest system. The use of a body belt as a positioning device system is acceptable (29 CFR 1926.502(e)).
4. Lifelines shall be secured above the point of operation to an anchorage or structural member capable of supporting a minimum dead weight of 5,000 pounds. One employee acting as anchor for another does not fulfill this requirement.
5. Lifelines, safety harnesses, and lanyards shall be used only for employee safeguarding. Ropes used for hoisting lines and other purposes shall not be used as lifelines. Positioning device systems and their components shall be inspected prior to each use and defective components shall be removed from service.
6. Roofing brackets shall be constructed to fit the pitch of the roof. Where practical, new construction should incorporate appropriate tie-offs or roof brackets as required to facilitate fall protection tie-off during roofing operations. In addition to the pointed metal projections, brackets shall be secured by nailing in place. The nails shall be driven full length into the roof. When rope supports are used, they shall consist of first-grade manila of at least 3/4-inch diameter, or equivalent.
7. Crawling boards shall not be less than 10 inches wide and one-inch thick, having cleats 1 x 1-1/2 inches. The cleats shall be equal in length to the width of the board and spaced at equal intervals not to exceed 24 inches. Nails shall be driven through and clinched on the underside. The crawling board shall extend from the ridgepole to the eaves when used in connection with roof construction, repair, or maintenance.
8. A firmly fastened lifeline of at least 3/4-inch rope shall be strung beside each crawling board for a handhold. Crawling boards shall be secured to the roof by means of adequate ridge hoods or equivalent effective means.

9. When hoisting lines are used to raise tools or materials to a roof greater than 16 feet from ground to eaves without a parapet (or with a parapet less than 30 inches in height), the employee on the roof shall be secured by an approved safety harness attached to a lifeline. The harness lanyard shall be a minimum of 1/2-inch nylon, or equivalent, with a maximum length to provide for a fall of no greater than 6 feet. The rope shall have a nominal breaking strength of 5,000 pounds.

40.8.2 Controlled Access Zone

1. A controlled access zone must be established and maintained as follows:
   a. Consist of ropes, wires, tapes, or equivalent materials and be supported by stanchions.
   b. Be flagged or marked at not more the 6 feet.
   c. Be rigged not less than 39 inches and not more than 45 inches from the working surface.
   d. Have a breaking strength of 200 pounds (min).
2. Signs must be posted to keep out unauthorized persons.
3. A safety monitoring system must include a designated safety monitor who is able to:
   a. Monitor the safety of other employees.
   b. Recognize fall hazards.
   c. Warn an employee when it appears that the employee is unaware of a fall hazard or is acting in an unsafe manner.
   d. Stay in sight of and in communication with the employee being monitored.
   e. Have no other responsibilities.

40.8.3 Ladders

Ladders come with their own set of fall hazards and are covered under specific safety regulations, namely the Constructions Safety Orders of the Code of Federal Regulations 29 CFR 1926.1053.

All ladders must meet regulated load requirements for its type. Refer to 29 CFR (Code of Federal Regulations) 1926.1053 (a)(1)(ii) and (a)(1)(iii) for specific requirements.

40.8.3.1 Special Requirements:

1. Ladders shall not be tied or fastened together to provide longer sections unless they are specifically designed for such use.
2. A metal spreader or locking device shall be provided on each stepladder to hold the front and back sections in an open position when the ladder is being used.
3. When splicing is required to obtain a given length of side rail, the resulting side rail must be at least equivalent in strength to a one-piece side rail made of the same material.
4. Ladder components shall be surfaced so as to prevent injury from punctures or lacerations, and to prevent snagging of clothing.
5. Wood ladders shall not be coated with any opaque covering, except for identification or warning labels, which may be placed on one face only of a side rail.
6. Except when portable ladders are used to gain access to fixed ladders (such as those on utility towers and other structures where the bottom of the fixed ladder is elevated to limit access), when two or more separate ladders are used to reach an elevated work area, the ladders shall be offset with a platform or landing between the ladders. (The requirements to have guardrail systems with toeboards for falling objects and overhead protections on platforms and landings are found in subpart M).
7. Fixed ladders without cages or wells shall have a clear width to the nearest permanent object of at least 15 inches on each side of the centerline of the ladder.

8. Fixed ladders where the length of climb is less than 24 feet but the top of the ladder is at a distance greater than 24 feet above lower levels shall be provided with cages, wells, ladder safety devices, or self-retracting lifelines.
9. Fixed ladders where the length of climb equals or exceeds 24 feet, the following applies:
   a. Ladder safety devices
   b. Self-retracting lifelines, and rest platforms at intervals not to exceed 150 feet
   c. A cage or well, and multiple ladder sections, each ladder section not to exceed 50 feet in length. Ladder sections shall be offset from adjacent sections, and landing platforms shall be provided at maximum intervals of 50 feet.

40.8.3.2 Cage Requirements

Cages must meet the following standards as identified in 29 CFR 1926.1053 (a)(20) ... (a)(20)(viii):

1. Horizontal bands fastened to the side rails of rail ladders, or directly to the structure, building or equipment for individual-rung ladders.
2. Vertical bars on the inside of the horizontal bands and fastened to them.
3. Extend not less then 27 inches or more than 30 inches from the centerline of the step or rang (excluding the flare at the bottom of the cage), and shall not be less than 27 inches in width.
4. The inside of the cage shall be clear of projections.
5. The horizontal bands shall be spaced not more than 4 feet vertically. Vertical bars shall be spaced at intervals not more than 9 and 1/2 inches on center horizontally.
6. The bottom of the cage shall be at a level not less than 7 feet or more than 8 feet above the point of access to the bottom of the ladder. The bottom of the cage shall be flared not less than 4 inches all around within the distance between the bottom horizontal band and the next highest band.
7. The top of the cage shall be a minimum of 42 inches above the top of the platform or the point of access at the top of the ladder, with provision for access to the platform or other point of access.

40.8.3.3 General Use of Ladders (including job-made, unless otherwise indicated)

1. When portable ladders are used for access to an upper landing surface, the ladder side rails shall extend at least 3 feet above the upper landing surface to which the ladder is used to gain access or, when such an extension is not possible because of the ladder's length, then the ladder shall be secured at its top to a rigid support that will not deflect, and a grasping device, such as a grabrail, shall be provided to assist employees in mounting and dismounting the ladder. In no case shall the extension be such that ladder deflection under a load would, by itself, cause the ladder to slip off its support.
2. Ladders shall be maintained free of oil, grease, and other slipping hazards.
3. Ladders shall not be loaded beyond the maximum intended load for which they were built, or beyond the manufacturer's rated capacity.
4. Ladders shall be used only for the purpose for which they were designed.
5. Ladders are to be used only on stable, level surfaces unless secured to prevent accidental displacement.
6. Ladders are not to be used on slippery surfaces unless secured or provided with slip-resistant feet. Slip-resistant feet are not to be used as a substitute for care in placing, lashing or holding a ladder that is used on slippery surfaces. This includes, but is not limited to, flat metal or concrete surfaces that are constructed so they cannot be prevented from becoming slippery.

7. If placed in any location where ladders can be displaced by workplace activities or traffic, such as in passageways, doorways, or driveways, they shall be secured to prevent accidental displacement, or a barricade is to be used to keep the activities or traffic away from the ladder.
8. The area around the top and bottom is to be kept clear.
9. Ladders are not to be moved, shifted or extended while occupied.
10. The top or top step of a stepladder is not to be used as a step.
11. Portable ladders with any structural defects are to be marked, or tagged "Do Not Use" and removed from service until repaired.
12. Fixed ladders with any structural defects are also to be removed from service, however, this can be accomplished by:
    a. Tagging it immediately with "Do Not Use" or similar language.
    b. Mark in a manner that readily identifies it as defective.
    c. Or block it off (such as a plywood attachment that spans several rungs).
    d. Ladder repairs must restore the ladder to a condition that meets its original design criteria before the ladder is returned to use.
13. Always face the ladder when ascending or descending.
14. Always use at least one hand to grasp the ladder when going up or down it.
15. Never carry any object or load that could cause you to lose your balance and fall.

40.8.4 Scaffolds

General requirements 29 CFR-1910.28 Construction 29 CFR-1 926.451:

1. Scaffolds must be provided for work that cannot be done safely by employees standing on ladders or on solid construction that is at least 20 inches wide.
2. The design of scaffolds must conform to design standards, or a licensed engineer must design scaffolds. Standards are based on stress grade lumber.
3. Metal or aluminum may be substituted if the structural integrity of the scaffold is maintained.
4. The erecting and dismantling of the most common (Tube and Coupler Scaffold) must be regulated as follows:
    a. Scaffold erection and a competent person must supervise dismantlement.
    b. Scaffold posts shall be accurately spaced, erected on suitable bases, and maintained plum.
    c. Runners shall be erected along the length of the scaffold located on both the inside and the outside post at even height. Runners shall be interlocked to form continuous lengths and coupled to each post. The bottom runners shall be located as close to the base as possible. Runners shall be placed not more than 6 feet 6 inches on centers.
    d. Bearers shall be installed transversely between posts and shall be securely coupled to the post bearing on the runner coupler. When coupled directly to the runners the coupler must be kept as close to the posts as possible.
    e. Bearers shall be at least 4 inches but not more than 12 inches longer than the post spacing or runner spacing.
    f. Cross bracing shall be installed across the width of the scaffold at least every third set of posts horizontally and every fourth runner vertically. Such bracing shall extend diagonally from the inner and outer runners upward to the next outer and inner runners.
    g. Longitudinal diagonal bracing shall be installed at approximately a 45-degree angle from near the base of the first outer post upward to the extreme top of the scaffold. Where the longitudinal length of the scaffold permits, such bracing shall be duplicated beginning at every fifth post. In a similar manner, longitudinal diagonal bracing shall

also be installed from the last post extending back and upward toward the first post. Where conditions preclude the attachment of this bracing to the posts, it may be attached to the runners.

h. The entire scaffold shall be tied to and securely braced against the building at intervals not to exceed 30 feet horizontally and 26 feet vertically.

i. Guardrails not less than 2 by 4 inches or the equivalent and not less than 38 inches or more than 45 inches high. Toeboards, shall be installed at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be provided with a screen between the toeboard and the guardrail, extending along the entire opening, consisting of No. 18 gauge U.S. Standard Wire 1/2-inch mesh or the equivalent, where persons are required to work or pass under the scaffolds.

5. Employees shall not work on scaffolds during storms or high winds.

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